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INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2024

MATHEMATICS: PAPER II

MARKING GUIDELINES

Time: 3 hours

150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

- (a) (i) 50
- (ii) 5
- (iii) $75\% \text{ of } 50 = 37,5$
 $\pm 57\% \text{ (allow } \pm 2)$
- (b) (i) C
- (ii) C

QUESTION 2

- (a) (i) $\frac{8!}{2! \times 2!} = 10\,080$
- (ii) $\frac{2 \times 6!}{2!} \div 10\,080 = \frac{1}{14}$
- (b) (i) $\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$
- (ii) $\left(\frac{1}{4} + \frac{1}{4}\right) - \frac{1}{16} = \frac{7}{16}$

QUESTION 3

- (a) All $\angle$'s of equilateral $\Delta = 60^\circ$
- (b) Shaded area = area of large Δ - area of small Δ
 $= \frac{1}{2}(80)(80)\sin 60^\circ - \frac{1}{2}(60)(60)\sin 60^\circ$
 $= 1\,212,44 \text{ cm}^2$

QUESTION 4

(a) (i) $D(4;0)$

(ii) $m_{DE} = \frac{-2-0}{-4-4} = \frac{1}{4}$

(iii) $y - 8 = \frac{1}{4}(x - 4)$
 $y = \frac{1}{4}x + 7$

(iv) $\tan \theta = \frac{1}{4}$
 $\theta = 14,04^\circ$
 $\hat{P}RB = 90^\circ - 14,04^\circ = 75,96^\circ$

(v) $Q(-4;6)$

(b) (i) Midpt of AB = $(1;2)$

(ii) $m_{AB} = \frac{3-1}{4+2} = \frac{1}{3}$

(iii) $\perp m = -3$
 $y - 2 = -3(x - 1)$
 $y - 2 = -3x + 3$
 $y = -3x + 5$

(iv) Perp. bisector of AB passes through M.

$$y = -3x + 5 \quad \text{and} \quad x = 0$$
$$\therefore y = -3(0) + 5 = 5$$
$$\therefore M(0;5)$$

(v) $r^2 = MB^2$ or $r^2 = MA^2$
 $= (4-0)^2 + (3-5)^2$ $= (-2-0)^2 + (1-5)^2$
 $= 20$

$$\therefore (x-0)^2 + (y-5)^2 = 20$$
$$x^2 + y^2 - 10y + 25 = 20$$
$$x^2 + y^2 - 10y + 5 = 0$$

QUESTION 5

$$(a) \quad \frac{(-2\sin\theta)(-\sin 36^\circ)(\cos 36^\circ)}{\sin 72^\circ} = \frac{\sin\theta \sin 72^\circ}{\sin 72^\circ}$$

$$= \sin\theta$$

$$(b) \quad 2\sin\theta\cos\theta - 4\sin^2\theta = 0$$

$$2\sin\theta(\cos\theta - 2\sin\theta) = 0$$

$$\sin\theta = 0^\circ \quad \text{or} \quad \tan\theta = \frac{1}{2}$$

$$\theta = 0^\circ + k.180^\circ \quad \theta = 26,57^\circ + k.180^\circ \quad k \in \mathbb{Z}$$

$$(c) \quad (i) \quad \frac{1 - 2\sin x \cos x}{\cos^2 x - \sin^2 x} = \frac{\sin^2 x + \cos^2 x - 2\sin x \cos x}{\cos^2 x - \sin^2 x}$$

$$= \frac{(\cos x - \sin x)(\cos x + \sin x)}{(\cos x - \sin x)(\cos x + \sin x)}$$

$$= \frac{\cos x - \sin x}{\cos x + \sin x}$$

$$(ii) \quad \frac{1 - \sin 30^\circ}{\cos 30^\circ} = \frac{1 - \frac{1}{2}}{\frac{\sqrt{3}}{2}}$$

$$= \frac{1}{2} \times \frac{2}{\sqrt{3}}$$

$$= \frac{\sqrt{3}}{3}$$

QUESTION 6

- (a) (i) $\frac{MN}{45} = \frac{108}{36}$ Prop. theorem PQ//LM
 $MN = 135$
- (ii) In $\triangle NPQ$ and $\triangle NLM$:
 $\hat{N}$ is common
 $\hat{NPQ} = \hat{NLM}$ corr $\angle$'s PQ//LM
 $\hat{PQN} = \hat{LMN}$ 3rd $\angle$ of Δ or corr $\angle$'s; PQ//LM
 $\therefore \triangle NPQ \sim \triangle NLM$ $\angle\angle\angle$
- $\frac{y}{x} = \frac{108}{72}$
 $= \frac{3}{2}$ or 1,5

- (b) (i) tan-chord theorem

- (ii) $\hat{BAD} = 90^\circ - x$ tan $\perp$ radius
 $\hat{E}_1 = 90^\circ - x$ ext $\angle$ of cyclic quad.

OR

- $\hat{E}_3 = 90^\circ$ $\angle$ in semi-circle
 $\hat{E}_2 = x$ $\angle$ s in same segm
 $\hat{E}_1 = 90^\circ - x$ $\angle$ s on str. line
- (iii) $\hat{F}_1 = 90^\circ - x$ int $\angle$ s of Δ
 $\hat{F}_1 = \hat{E}_1$
 $\therefore CFDE$ is a cyclic quad ext $\angle =$ int. opp. $\angle$

SECTION B**QUESTION 7**

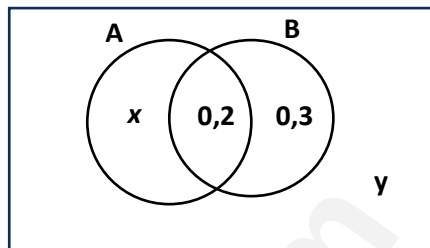
$$P(A \text{ and } B) = P(A) \times P(B)$$

$$0,2 = (x + 0,2)(0,5)$$

$$0,2 = 0,5x + 0,1$$

$$x = 0,2$$

$$y = 1 - 0,7 = 0,3$$

**QUESTION 8**

(a) $x = 30,78$

(b) $4,80$

(c) (i) $\frac{3 \times 5 + 9 \times 1}{12} = 2 \text{ } ^\circ\text{C per month or add 26 to total}$

(ii) Standard deviation will decrease.
Range will decrease.

QUESTION 9

(a) $GA \parallel CD$ given
 $\hat{O}_1 = \hat{D}_1$ tan chord
 $\hat{O}_1 = \hat{C}$ tan chord
 $\therefore \hat{D}_1 = \hat{C}$

but they are corresponding $\angle$ s

$GC \parallel AD$

$AGCD$ is a parm

both pairs of opp sides $\parallel$

(b) $\hat{G}_1 = \hat{C}$ corr $\angle$ s $EA \parallel CO$
 $\hat{C} = \hat{D}_1$ proven above
 $\hat{D}_1 = \hat{A}_2$ alt $\angle$ s $EA \parallel CO$
 $\hat{A}_2 = \hat{O}_2$ tan chord
 $\therefore GAOC$ is a cyclic quad ext $\angle =$ int. opp. $\angle$

QUESTION 10(a) In $\triangle ABP$:

$$\frac{AR}{RB} = \frac{AS}{SP} \quad \text{line } \parallel \text{ one side of } \triangle$$

$$\frac{AS}{SP} = \frac{4}{3}$$

(b) In $\triangle ABP$:

$$AP = PC = 7k \quad \text{P given as mdpt}$$

$$\frac{AS}{SC} = \frac{4}{10} = \frac{2}{5}$$

(c) In $\triangle RSC$

$$\frac{SP}{PC} = \frac{RT}{TC} = \frac{3}{7} \quad \text{line } \parallel \text{ one side of } \triangle$$

$$(d) \quad \frac{\text{Area } \triangle TPC}{\text{Area } \triangle RSC} = \frac{\frac{1}{2} TC \cdot PC \sin \hat{A}CR}{\frac{1}{2} RC \cdot SC \sin \hat{A}CR}$$

$$= \frac{TC}{RC} \cdot \frac{PC}{SC}$$

$$= \frac{7}{10} \times \frac{7}{10}$$

$$= \frac{49}{100}$$

QUESTION 11

$$(a) \quad \frac{\sin E}{20} = \frac{\sin 30^\circ}{8}$$

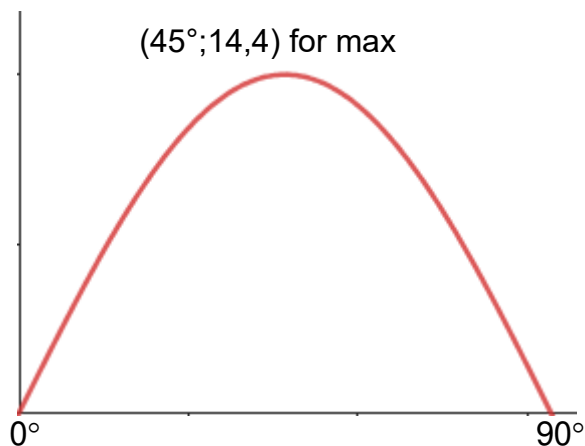
$$\sin E = \frac{5}{4}$$

$$\text{but } -1 < \sin E < 1$$

$\therefore \triangle DEF$ does not exist

$d \geq 10$, thus $d = 10$ is the min value for $\triangle DEF$ to exist

$$(b) \quad (i) \quad y = \frac{144}{10} \sin 2x \\ = 14,4 \sin 2x$$



$$(ii) \quad y \in [0; 14,4] \quad \text{or} \quad 0 \leq y \leq 14,4$$

$$(iii) \quad 14,4 \text{ m}$$

$$(iv) \quad 14,4 = 14,4 \sin 2x \\ 1 = \sin 2x \\ x = 45^\circ \text{ (can also read from graph)}$$

$$(v) \quad 7,2 = 14,4 \sin 2x \\ \sin 2x = \frac{1}{2} \\ 2x = 30^\circ \quad \text{or} \quad 2x = 150^\circ \\ x = 15^\circ \quad \text{or} \quad x = 75^\circ$$

$$(vi) \quad \frac{v^2}{10} \sin(2 \times 48^\circ) = 23,37 \\ v^2 = \frac{23,37 \times 10}{\sin 96^\circ} \\ v^2 = 234,9872... \\ v = 15,33 \text{ m/sec}$$

QUESTION 12

$$x^2 + 3x + \left(\frac{3}{2}\right)^2 + y^2 - 6y + (-3)^2 = 9 + \frac{9}{4} + 9 \\ \left(x + \frac{3}{2}\right)^2 + (y - 3)^2 = \frac{81}{4} \\ \text{radius of MP} = \frac{9}{2} + 1 = \frac{11}{2} \\ \left(x + \frac{3}{2}\right)^2 + (y - 3)^2 = \frac{121}{4}$$

QUESTION 13

$$\text{Area semi-circle } ADC = \frac{1}{2}\pi\left(\frac{1}{2}AC\right)^2$$

$$\text{Area semi-circle } AB = \frac{1}{2}\pi\left(\frac{1}{2}AB\right)^2$$

$$\text{Area semi-circle } BC = \frac{1}{2}\pi\left(\frac{1}{2}BC\right)^2$$

Area ADC – area AB – area BC

$$= \frac{1}{2}\pi\left(\frac{1}{2}AC\right)^2 - \frac{1}{2}\pi\left(\frac{1}{2}AB\right)^2 - \frac{1}{2}\pi\left(\frac{1}{2}BC\right)^2$$

$$= \frac{1}{8}\pi(AC^2 - AB^2 - BC^2)$$

$$= \frac{1}{8}\pi[(AB + BC)^2 - AB^2 - BC^2]$$

$$= \frac{1}{8}\pi[AB^2 + 2AB.BC + BC^2 - AB^2 - BC^2]$$

$$= \frac{1}{8}\pi[2AB.BC]$$

$$= \frac{1}{4}\pi AB.BC \quad \text{_____ (1)}$$

Join AD and DC

$$\hat{ADC} = 90^\circ \quad \angle \text{ in semi-circle}$$

In $\triangle ABD$ and $\triangle DBC$:

$$\hat{ABD} = \hat{DBC} = 90^\circ$$

$$\hat{A} = \hat{BDC} \text{ because } \hat{D}_1 + \hat{D}_2 = 90^\circ \text{ and } \hat{A} + \hat{D}_1 = 90^\circ$$

$$\therefore \triangle ABD \sim \triangle DBC \quad \lll$$

$$\frac{AB}{DB} = \frac{BD}{BC} = \frac{AD}{DC}$$

$$BD^2 = AB.BC \quad \text{_____ (2)}$$

$$t^2 = AB.BC$$

Substitute (2) in (1):

$$\text{Area} = \frac{1}{4}\pi t^2$$

Total: 150 marks